ELECTRONIC STILL CAMERA FOR CAPTURING AND CATEGORIZING IMAGES

FIELD OF THE INVENTION

This invention pertains to the field of electronic imaging systems, and in particular to a digital electronic still camera of the type that is used with a host computer.

BACKGROUND OF THE INVENTION

As understood in the prior art, a digital electronic still camera is a device which uses an electronic sensor to capture an image; signal processing to represent the captured signal numerically; and some storage device to preserve the numerical image data. It is further known for a digital electronic still camera to use a removable storage device, such as an integrated circuit memory card, to store images. For instance, U.S. Pat. No. 5,016,107 describes an electronic still camera utilizing image compression and providing digital storage in a removable memory card having a static random access memory. In this camera, the integrated circuits in the removable memory card store image data and a directory locating the data.

Coordination between a digital camera and a computer is generally known in the prior art. FIG. 1 shows a known electronic still photography system useful for inputting images to a computer. The system includes an electronic camera 1 with an electronic sensing section 1*a*, a digital processing section 1*b*, a memory card slot 2, and a removable memory card 3; and a host computer 4 with a built-in memory card reader 5, a printer 6*a*, a display 6*b*, a keyboard data entry device 7 and a disk drive 8. Images are captured by the sensing section 1*a* in the camera 1, manipulated in the processing section 1*b*, stored on the memory card 3, and transferred from the card 3 to the host computer 4. The software used to control the sensing and processing sections 1*a* and 1*b* in the camera is located in firmware memory 1*c* in the camera 1. The application software used to control the playback operations of the host computer is supplied, at least in part, by the camera manufacturer. For instance, the manufacturer may provide a special disk or memory card that comes with the camera. The application software is transferred to the computer hard drive 8, and then downloaded to a computer random access memory (RAM) memory 9*a*, where the program is used by a central processing unit (CPU) 9*b*.

Digital cameras, such as the Kodak Digital Science DC40™ camera sold by Eastman Kodak Company, allow almost a hundred images to be stored. Because the images are stored as sequentially numbered images, it can be difficult and time consuming to locate a group of images of interest from all of the images stored in the camera. In a typical usage, an insurance adjuster may take a number of photos in processing a number of different claims during one day's operations. It would be desirable to be able to identify the images of each group, for example by claim number or client name. It may be further desirable to allow this information, along with the date and time or a company logo, to be optionally included with the image data. This ensures that any prints made from the camera can be easily identified. Such processing of the captured images is today performed in a host computer, such as the host computer 4 in FIG. 1.

The Kodak Professional Digital Camera System (model DCS-100) included a digital camera tethered by cable to a separate digital storage unit (DSU). The DSU, similar to the computer 4 of FIG. 1, contained a hard drive for storing

images, a small image display, and a keypad for manipulating the images. For images that had already been captured by the camera, the system included a "tag" feature that allowed a user to flag selected images for later display or for uploading from the DSU to another computer. Suppose that a user wanted to tag a couple of already-captured images for later viewing or uploading. The first of the images would be brought up on the display and a "tag" button on the keypad would be pressed, and so on with the other images that are to be tagged. Then if the user presses a "find tags" key on the keypad, the first of the tagged images is displayed (and/or uploaded). With a second press of the "find tags" key, the second tagged image is displayed (and/or uploaded), and so on.

Another embodiment of this camera, the Kodak Hawkeye II camera, also allowed the user to type in a name for any one image after the image was taken, and to add a "note" text-string to the image file. Both cameras allowed a simple division of already-captured images into "tagged" and "not-tagged" images and required a pattern of keystrokes subsequent to capture for every image of interest. In particular, the tagging feature functioned more as a post-capture data gatekeeper than as a useful tool for image handling. Anything more complex in the way of data organization requires, as shown in FIG. 1, the use of a special application program in the host computer 4 to organize and sort the image data. Consequently, it would be desirable to have an electronic still system that could handle image content more efficiently in the field than is presently the case.

SUMMARY OF THE INVENTION

The present invention is directed to overcoming one or more of the problems set forth above. Briefly summarized, according to one aspect of the present invention, an electronic camera captures images representing a variety of subjects and categorizes the image according to subject matter. The camera comprises an image sensor for the images, a converter stage for converting the images into digital image data, and a memory for storing a plurality of categories providing classification of the images by subject. A processor in the camera has the capability of assigning the plurality of categories to the images captured by the camera, with each category providing subject classification of one or more images. A user then interacts with a user control on the camera in order to select one or more of the categories for the images, and an output image signal is then generated including the digital image data corresponding to the images and the one or more categories selected by the user control.

The advantage of the invention is that the known provision of a simple post-capture "tag" is enlarged into useful pre-capture categories that can effectively manage images according to variable subject content. According to this invention, a digital camera includes a display-based "tag" icon/feature which the user can set to an appropriate category before taking a group of pictures. The category names can be defaults, or can be names and optional text (i.e., account number) and/or graphics overlays (i.e., company logo) entered via a host computer and uploaded to the camera before the pictures are taken. When the user selects a particular category, the category name is stored along with the image data in the image file, and any text and graphics logo, as appropriate, are overlaid onto the image. When downloading the images to a host computer, the user can select a category and download only the images which have a particular category name, or the images can be stored in folders labeled with each category name.

These and other aspects, objects, features and advantages of the present invention will be more clearly understood and

appreciated from a review of the following detailed description of the preferred embodiments and appended claims, and by reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagram of a known electronic imaging system incorporating a digital camera for inputting images to a host computer.

FIG. 2 is a block diagram of an electronic camera configured according to the invention to process and categorize images.

FIG. 3 is a diagram of the status display panel and the user control switches used in the camera shown in FIG. 2.

FIG. 4 is a process diagram for categorizing images according to default parameters stored in the camera shown in FIG. 2.

FIG. 5 is a process diagram for categorizing images according to externally generated parameters supplied to the camera shown in FIG. 2.

FIG. 6 is an example of categories that are customized from a host computer.

FIG. 7 is an example of a file format resulting from customized categories.

FIG. 8 is an example of an image display with customized category information overlaid into the image.

FIG. 9 is an additional diagram of the status display panel and the user control switches set up for activating an overlay feature.

FIG. 10 is an example of an image file management structure using categories.

DETAILED DESCRIPTION OF THE INVENTION

Because electronic still cameras employing electronic sensors are well known, the present description will be directed in particular to elements forming part of, or cooperating more directly with, apparatus in accordance with the present invention. Elements not specifically shown or described herein may be selected from those known in the art. Certain aspects of the embodiments to be described are provided in software. Given the system description as described in the following materials, all such software implementation is conventional and within the ordinary skill in such arts.

FIG. 2 shows an electronic still camera capable of categorizing images as taught by the invention. The electronic still camera is divided generally into an input section A and a compression and recording section B. The input section A includes an exposure section 10 for directing image light from a subject (not shown) toward an image sensor 12. A flash unit 11 may be used to illuminate the subject. Although not shown, the exposure section 10 includes conventional optics for directing the image light through a diaphragm, which regulates the optical aperture, and a shutter, which regulates exposure time. The sensor 12, which includes a two-dimensional array of photosites corresponding to picture elements of the image, is a conventional charge-coupled device (CCD) using, e.g., either well-known interline transfer or frame transfer techniques. The sensor 12 is exposed to image light to capture a particular image; accordingly, analog image charge information corresponding to the particular image is generated in respective photosites. The charge information is applied to an output diode 14, which converts the charge information to analog image signals

corresponding to respective picture elements of the particular image captured.

The analog image signals are applied to an A/D converter **16**, which generates digital image data from the analog input signals for each picture element. The digital image data is applied to an image buffer **18** for storing one or more images, albeit shown in FIG. **2** as a random access memory (RAM) with storage capacity for a plurality of still images. A programmed control processor **20** generally controls the input section A of the camera by initiating and controlling exposure (by operation of the diaphragm and shutter (not shown) in the exposure section **10**), by controlling the flash unit **11**, by generating the horizontal and vertical clocks needed for driving the sensor **12** and for clocking image information therefrom, and by enabling the A/D converter **16** in conjunction with the image buffer **18** for each signal segment relating to a picture element. Exposure control would typically be effected by using ambient light information from a photocell **19**, and a shutter button **21** allows the user to initiate a capture cycle. The processor **20** also receives date and time information from a date/time generator **20***a*.

Once a certain amount of digital image data has accumulated in the image buffer **18**, the stored data is applied to a programmed digital signal processor **22**, which controls the throughput processing rate for the compression and recording section B of the camera. The algorithms and other operating code used by the processor **22** are stored in an algorithm memory **28**. The digital signal processor **22** compresses each still image stored in the image buffer **18** according to any one of a number of known image compression algorithms, such as the well-known JPEG (Joint Photographic Experts Group) discrete cosine transformation-based compression algorithm. The processor **22** applies the compression algorithm from the memory **28** to the digital image data, and sends the compressed data to a removable storage device via a signal port **26**. However, while compression is shown in the camera of FIG. **2**, compression is not a necessary feature, and uncompressed data could be stored instead in the removable storage device.

In this example, the signal port **26** is a card interface and the removable storage device is a memory card **24**. While a memory card **24** is shown in this system as the storage device, other devices may be used, such as a floppy disk magnetic medium, a small hard drive, or optical storage (in the latter cases, suitable conventional reading/writing apparatus would be provided in the camera, e.g., magnetic or optical read/write head..etc.). A representative memory card is a card adapted to the PCMCIA card interface standard, such as described in the *PC Card Standard, Release* 2.0, published by The Personal Computer Memory Card International Association, Sunnyvale, Calif., September 1991. The memory card **24** accordingly contains solid state memory **24***a*, such as Flash EPROM memory, which the card uses to store image data files.

According to this invention, the digital camera includes a categorization feature which enables a user to establish an appropriate category, providing classification of the images by subject, before taking a group of pictures. The category information can be default code symbols (A,B,C, etc.), or can be externally-generated category information, such as names and optional text (i.e., account numbers) and/or graphics overlays (i.e., company logos), which is entered via a host computer and uploaded to the camera through the signal port **26** before the pictures are taken or via cable connection. After the user selects a particular category, the image is captured and the category information is stored in

the removable storage device along with the image data in the image file, and any text and graphics logo, as appropriate, are overlaid onto the image. When downloading the images to a host computer, the user can select a particular category and download only the images which have a particular category identifier, or the images can all be downloaded and stored in file folders labeled with each category name.

Consequently, the memory card **24** contains additional memory to store header files **24***b* containing category information helpful in providing classification of the images by subject matter. Such category information may include default tag codes, such as simple alphabetic identifiers A, B, C, D, etc., or alphanumeric names that can be associated with specific images according to subject matter. The header files **24***b* can also contain strings of text that identify particular images and separate graphics images that signify or otherwise identify subject matter. The header files **24***b* can also contain instructions to overlay all or part of the category information into the image data files **24***a*, or, alternatively, the digital signal processor **22** can access an algorithm in the algorithm memory **28** which accomplishes the overlay, and then stores all or part of the category information with the image data. It is a further feature of this invention that the externally generated category information can be supplied to the digital camera through the signal port **26**. Such externally generated category information can be stored in the Card Information Structure (CIS) of the PCMCIA Format (as described in the aforementioned *Release* 2.0), in the header data file **24***b*, or in a portion of the memory space of the memory **24***a* used to store the image data.

The camera also contains a memory section **31**, including firmware memory **32***a* with operating code for the camera, as well as RAM instruction memory **32***b* connected to receive code from the memory card **24**. When the memory card **24** is inserted into the camera, the processor **20** uses the firmware algorithms in the memory **32***a* to determine if the memory card **24** contains externally generated files which can be used by the camera. If not, the firmware algorithms supplied with the camera in the memory **32***a* are used by the programmable processor **20**. In particular, the default category parameters are stored in the firmware memory **32***a* and accessed by the processor **20**. If the card does contain appropriate externally generated category information, however, these are downloaded from the header file section **24***b* of the card **24** to the RAM instruction memory **32***b* and used by the programmable processor **20** in place of some portion of the firmware algorithms supplied with the camera from the firmware memory **32***a*. In this way the camera can execute customized category definitions which provide higher quality or more complex categorization of pictures.

User control is provided by a status display **30** connected to the control processor **20** for displaying information useful in operation of the camera, and by a set of user control switches **29**. The set of user control switches **29** are also connected to the processor **20** for entering, highlighting, and selecting information displayed on the status display **30**. In accordance with invention, the status display **30** is a liquid crystal display (LCD) having a panel configuration **50** such as shown in FIG. **3**, which includes a "tag" icon **52***a*, and an alphanumeric segmented section **52***b*. (The panel configuration includes other typical icons, such as a battery level icon **52***c*, a flash mode icon **52***d*, a self-timer icon **52***e*, and an image delete icon **52***f*.) The user control switches **29** include a toggle switch **54** and a select button **56**. The toggle switch **54** is used to toggle to a setting once an icon has been activated by the select button **56**. For example, if the flash

mode icon **52***d* is highlighted and showing that it is the currently active control, pressing the select button would activate the tag icon **52***a* and make it the currently active control.

While not important to this invention, other information displayed on the status display **30** might include typical photographic data, such as shutter speed, aperture, exposure bias, color balance (auto, tungsten, fluorescent, daylight), high/low resolution, low light, exposure modes (aperture preferred, shutter preferred), and so on. Moreover, other information unique to this type of camera may be displayed. For instance, the memory card **24** would ordinarily include a directory signifying the beginning and ending of each stored image. This would show on the display **30** as either (or both) the number of images stored or the number of image spaces remaining, or estimated to be remaining.

If externally generated category information is present in the header file **24***b* on the card **24**, it can also be identified on the status display **30**. For instance, the externally generated category information, such as names, text strings, and graphics images can be identified and displayed if the status display **30** has the appropriate display capability. Alternatively, the toggle switch **54** can be used to cycle through alphanumeric names that are provided from the host computer and displayed on the segmented section **52***b*. Selecting any one name then automatically accesses any text string or graphics image that might be associated with the name in the instruction memory **32***b*, and stores such strings or graphics image with the digital image data. The camera may also have the additional feature of overlaying a text string, or date and/or time from the date/time generator **20***a*, into the image. Whether or not the date/time or text string is overlaid in the images of any particular category can be controlled by overlay control information for each category present in the header file **24***b*. Alternately, this can be done from additional icons in the panel configuration **50** and from the user control switches **29**, as shown in FIG. **9**. Date, time, name, and text are separately activated by the toggle switch **54**, and "on" (overlay active) or "off" icons are activated by the select switch **56**. It is assumed that an uploaded graphics image would always overlay into the image, but if this is not always desirable, then a separate graphics icon may be provided for overlay control.

The process for categorizing images according to default parameters is shown in FIG. **4**, and the process for categorizing images according to customized, externally generated parameters is shown in FIG. **5**. Referring first to FIG. **4**, when the camera is first turned on, the "tag" icon **52***a* will be shown only in outline form (step **60**). The inner part of the "tag" icon **52***a* will fill to indicate when the user has positively selected the tag feature by activation of the user control switches **29**. In the default mode, there are a predetermined plurality of possible categories, for example, five alphabetic categories A,B,C,D,E and NONE (or OFF). With the tag icon **52***a* activated, the user will select categories A,B,C,D,E,NONE (repeat sequence A,B, etc.) by pressing the toggle switch **54** (step **61**). Each press of the switch **54** causes a different tag code to be displayed on the alphanumeric segment **52***b*.

After the tag is selected, the user can activate other icons by use of the select button **56**. Then, when the shutter button **21** is pressed, the selected category (tag) is associated with the digital image data (steps **62**, **63**). Then the steps **62**, **63** are repeated for any additional images in the same category. If a new category is desired, the process reverts to step **61**. When all the images are captured, the user connects the camera (by cable) or the memory card **24** to a host computer

(step 64), such as the host computer 4 illustrated in FIG. 1. Using software supplied by the camera manufacturer, the user opens a camera application and chooses the desired category (step 65). Then the images from appropriate categories stored in the camera, or the memory card 24, are downloaded to proper file folders according to the category data stored with the digital image data in each file (step 66).

The user may also customize the tags using the host computer. As shown in the process diagram of FIG. 5, a user inputs category information, such as category names, and related text or graphics images, from the host computer (step 70). The user then downloads the category information to the camera (step 71). This may be done through a tethered connection to the camera, or by writing appropriate files into the memory card 24. The user turns on the camera (step 72), and selects an appropriate category (step 73). At this stage, the user can also decide to activate the overlay capability for date, time, text, and graphics images. The picture is taken (step 74), and the category information is optionally overlaid into the image (step 75). The digital image data is then stored in the memory card 24 together with category information, either separately or as overlaid into the image data (step 76). The remaining steps are substantially the same as in FIG. 4.

FIGS. 6, 7, and 8 show examples of categories customized from a host computer, following on the previously mentioned claims adjuster example, and the resulting file format and image display. As shown in FIG. 6, the categories (tags) are given names, optional text strings, and graphics. The category information also includes overlay control information indicating whether or not the text string, date, and time should be overlaid into the image. In this example, the user, a free-lance claims adjuster, has created four different categories (H111 and H122) for different insurance claims from a first insurance company, one (F123) for a claim from a second insurance company, and one (KIDS) for personal images. The user also indicates whether the text string should be overlaid into the image, and whether the camera should overlay the date and/or time in the image. This category information, including names, text, and graphics, is then downloaded to the host computer from the memory card 24. A typical technique for such downloading is described in U.S. Ser. No. 08/219,608, entitled "Electronic Imaging System Using a Removable Software-Enhanced Storage Device", which is to issue as U.S. Pat. No. 5,477,264 on Dec. 19, 1995.

When programmed by the host or memory card 24, the number of tag categories that can be selected in the camera, and the four-letter name of each category, is as set by the user via the host computer. The user selects the appropriate category before taking a sequence of images. The tag names and text are then included in the image files, as shown in FIG. 7. In this example, the user selected Tag name H111 and took images #1–2. The user then selected Tag name KIDS and took images 3–5. Finally, the user selected tag name F123 and took image #6. As the images are captured and processed, the appropriate overlay information for the tag chosen is used. For the category "F123", the tag indicates that the image should include a graphics overlay, the text "Claim #123", and the date/time, as shown in FIG. 8. In a further embodiment shown in FIG. 10, images are stored on the removable memory card 3 within a file 80 containing a group of files corresponding to each category. For example, file 82 contains images #1 and #2 having tag name "H111", file 84 contains images #3, #4 and #5 having tag name "KIDS", and file 86 contains image #6 having tag name "F123".

After the images from the camera are stored on the memory card 24, the card is inserted into the computer

memory card reader 5 (see FIG. 1). In applications where the memory card may contain category information which can be used by the computer, the computer uses the software supplied with the camera to check if the memory card contains such information. If the card does contain appropriate category information, this information is downloaded from the card to the RAM instruction memory *9a* and used by the CPU *9b* in combination with the software algorithms from the hard drive 8. This allows a quick and convenient way of categorizing the images accessed by the computer, without requiring further intervention from the host computer.

According to the invention shown in FIG. 2, the images are transferred from the camera to the computer via the removable memory, rather than a cable interface. Therefore, the camera does not have to be in the same location as the computer. This makes it possible to view the images from the camera in many different locations, on many different computers, as long as the computer has the ability to both accept the removable memory and correctly process the image data. Since the removable memory can be used to store code for processing the image data in the computer, this code can include the processing algorithms needed to download the stored images according to the stored categories. The advantage of storing the processing algorithms on the removable memory is that it eliminates the need for a separate means of supplying the code, such as the floppy disk. Supplying the algorithms along with the images on the removable memory, such as a PCMCIA card, makes it possible for any computer capable of reading the image data from the card to also download and utilize the algorithms needed to process the image data in order to create one or more files of categorized images.

The invention has been described with reference to a preferred embodiment. However, it will be appreciated that variations and modifications can be effected by a person of ordinary skill in the art without departing from the scope of the invention. For example, the image files shown in FIG. 7 could be stored in many different types of optical, magnetic, or solid-state digital memory. The category customization information shown in FIG. 6 could be transferred from the computer 3 to the camera 1 via a cable connection instead of via a removable memory card, or the camera 1 could include means for entering category customization information.

PARTS LIST

1 ELECTRONIC CAMERA
1A ELECTRONIC SENSING SECTION
1B DIGITAL PROCESSING SECTION
1C FIRMWARE MEMORY
2 MEMORY CARD SLOT
3 REMOVABLE MEMORY CARD
4 COMPUTER
5 MEMORY CARD READER
6a PRINTER
6b DISPLAY
7 KEYBOARD
8 HARD DRIVE
9A COMPUTER RAM MEMORY
9B CPU
10 EXPOSURE SECTION
11 FLASH UNIT
12 IMAGE SENSOR
14 OUTPUT DIODE
16 A/D CONVERTER
18 IMAGE BUFFER
20 CONTROL PROCESSOR